Memo

To: NPDES Permit Writers

From: Tom Atkinson

Date: July 24, 2009 (Updated March 25, 2021)

Re: Deriving effluent limitations from the Raccoon River TMDL

A Total Maximum Daily Load (TMDL) has been prepared by the department and approved by EPA Region VII that addresses drinking water use impairments, caused by elevated levels of nitrates, of the Raccoon River upstream of the City of Panora Water Works and the City of Des Moines Water Works. The TMDL also addresses the recreational use impairments, due to elevated levels of pathogen indicating bacteria, of multiple segments of both the North Raccoon River and the Raccoon River. The approved TMDL specifies wasteload allocations for Total Kjeldahl Nitrogen (TKN) and *E. coli* bacteria for point sources in the watershed. The wasteload allocations in the TMDL are expressed as daily mass loads for both TKN and *E. coli*. This procedure addresses how the department will implement this TMDL and the associated wasteload allocations.

In light of the decision by the U.S. Court of Appeals for the D.C. Circuit in *Friends of the Earth, Inc. v. EPA, et al.*, the TMDL must specify the total maximum daily loads as "daily" loads. The EPA issued a memo on November 15, 2006 which discusses the implications the *Friends of the Earth* decision has on NPDES permits. This memo notes that the decision does not affect the NPDES permitting authority's ability to use all available tools to translate TMDLs and their wasteload allocations into enforceable effluent limitations in discharge permits.

As noted above the TMDL is required to specify WLA as daily loads, which for *E. coli*, results in a WLA that is impractical to use as an NPDES permit limit. The concentration limits provided in a WLA from the Water Resources Section will be consistent with this TMDL.

The wasteload allocations for TKN in the Raccoon River TMDL were set as the estimated current discharges, recommending no reductions from point source discharges. These estimates were calculated in one of three ways which resulted in average daily discharges from each facility. For facilities with a design capacity for TKN identified in the Construction Permit process, this capacity was set as the estimated daily load. For most facilities the population equivalent was multiplied by 0.027 lbs of TKN/ca/day, which is an accepted literature value for the amount of nitrogen contributed to domestic wastewater by each person. If organic industrial waste was present this was used or added to the estimate. A similar approach was used for estimating loads from controlled discharge lagoons, however the estimate was averaged over the expected discharge periods, based on historical discharge records.

For the purpose of trying to implement similar TMDLs in a consistent manner, the following procedures are detailed to implement the Raccoon River nitrate TMDL in a similar fashion as the Cedar River nitrate TMDL.

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Attachment #1 lists the TKN limits, which were derived from the wasteload allocations listed in the Raccoon River nitrate TMDL using the following procedures and the data available as of the date of this memo.

FOR CONTINUOUS DISCHARGE FACILITIES

The USEPA (1991) *Technical Support Document for Water Quality-Based Toxics Control* contains the statistical permit limit derivation procedure. The department utilizes a similar procedure, found in the *Supporting Document for Iowa Water Quality Management Plans,* to derive WQBELs. Due to the procedures used to calculate the wasteload allocations in the Raccoon River nitrate TMDL, the wasteload allocations shall be used as the long-term average (LTA) in the permit derivation procedure. Using the multipliers in the tables in Attachment #2 the maximum daily limit (MDL) and an average monthly limit (AML) can be calculated.

The multiplier used is dependent on factors such as effluent variability, number of samples collected per month, and the targeted percentile of occurrence probability. For this procedure, the LTA multipliers for both the MDL and AML calculations shall be based on the 99th percentile occurrence probability. The effluent variability is expressed as the coefficient of variability (CV). Because there is a very limited amount of data that is available, the default CV of 0.6 shall be used until more data is available. At the time sufficient data (at least 10 data points) are available the CV can be calculated by dividing the standard deviation of the data by the average of the data. For purposes of determining the LTA multiplier for the AML, the number of samples per month shall be four unless more frequent sampling is required.

For example, the wasteload allocation in the TMDL for the City of Storm Lake WWTP is 1080 lbs/day. Using the default CV of 0.6 and four samples per month, the daily LTA multiplier is 3.11 and the monthly LTA multiplier is 1.9. Using this information, effluent limitations are calculated as follows:

MDL = 1080 lbs/day * 3.11 = 3359 lbs/day
AML = 1080 lbs/day * 1.9 = 2052 lbs/day

Effluent limits that are calculated using this procedure are deemed to be consistent with the assumptions and requirements of the wasteload allocations in the TMDL.

NPDS
Monitoring requirements shall be added for total nitrogen as follows:

- WW Parameter = NITROGEN, TOTAL KJELDAHL (AS N);
- Monitoring Location = FINAL EFFLUENT;
- Sampling Frequency = Per Chapter 63 – Table II;
- Sample Type = 24 HOUR COMPOSITE;
- Basis for Monitoring = BPJ;
- Limits Basis = WATER QUALITY STANDARDS/WLA;
- Season Indicator = Yearly; C
- oncentration Units = MG/L;
- Mass Units = LBS/DAY.

The limits calculated above shall be entered as 30 Day Average and Daily Maximum mass limits. NOTE: For facilities with a population equivalent (P.E.) less than 501, the Sampling Frequency should be 1 EVERY 2 MONTHS.

FOR CONTROLLED DISCHARGE LAGOON FACILITIES

Although this TMDL specifies maximum daily loads for controlled discharge lagoon facilities, for the purpose of consistency, the WLA shall be converted to an annual load and limited as pounds per year. The annual WLA values are listed in the Annual Load (lbs TKN/year) column of Attachment #1. This procedure addresses how the department will implement this TMDL and associated wasteload allocations to regulate the TKN discharge on an annual basis from controlled discharge lagoons.

CDL permits will include limits for the parameter 'Annual Total Kjeldahl Nitrogen Discharged' (ANN TKN-N). Permits will specify:
- a monitoring location of 'Final Effluent',
- a monitoring frequency of once every 12 months,
- a sample type of 'Calculated',
- a monitoring basis of 'Best Professional Judgment',
- a limits basis of 'WATER QUALITY STANDARDS/WLA' ,
- a season indicator of 'Yearly', mass units of 'lbs/year', and
- a Limit Data Type of 'ANNUAL TOTAL'.

The wasteload allocation from the approved TMDL has been converted to lbs/year and has been identified in Attachment #1. The Annual Load (lbs TKN/year) shall be included in the permit as an annual total limit for this parameter.

The following special monitoring requirement will also be included under the parameter Annual Total Kjeldahl Nitrogen Discharged.

Annual Total Kjeldahl Nitrogen:
The annual total Kjeldahl nitrogen discharge limit is the total pounds of Kjeldahl nitrogen that can be discharged during a calendar year (January – December). The total pounds of Kjeldahl nitrogen discharged per year shall be the sum of the lbs of Kjeldahl nitrogen discharged during each month that a discharge occurred. You must report the total pounds per year of Kjeldahl nitrogen discharged during the previous calendar year on day 1 of the column labeled "ANN TKN-N" on the February Discharge Monitoring Report (DMR) each year.

In addition to limits and reporting of the annual amount of Kjeldahl nitrogen discharged, permits will also specify monitoring (no limit) for the parameter Total Kjeldahl Nitrogen (TKN) on the final effluent with a monitoring frequency based on Chapter 63, Table 1 for ammonia nitrogen {once or twice per drawdown depending on design PE}. The sample type will be 'Grab'.

The following special monitoring requirements will be included under the parameter Total Kjeldahl Nitrogen (TKN).

The discharge flow shall be reported for each day discharge occurs in the column labeled "FLO-OUT" on the Monthly Operating Report (MOR). The concentration of total Kjeldahl nitrogen shall be reported for each day a sample is collected and analyzed for total Kjeldahl nitrogen.

The total pounds of Kjeldahl nitrogen discharged shall be calculated for each calendar month during which there is a discharge as follows:

*Average daily flow for the month (MGD) * Average total Kjeldahl nitrogen concentration (mg/L) for the discharge period* 8.34 * Number of days discharge occurred during the month = total lbs of Kjeldahl nitrogen per month*

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ATTACHMENT #1

Facility Name	WLA (lbs TKN/day)	2000 Pop/PE	AML (lbs TKN/day)	MDL (lbs TKN/day)	Annual Load (lbs TKN/year)
Rembrandt Enterprises, Inc	232		441	722	
City of Rembrandt	117	407			4011
City of Fonda	251	648			6386
City of Laurens	359	1476			14546
Spectra Health Care Facility STP	15	84			828
Tyson Fresh Meats Storm Lake	3260		6194	10139	
City of Storm Lake	1080		2052	3359	
City of Newell	34	887			12410
Albert City	19		36	60	
Sac City	74		140	230	
City of Marathon	8		15	25	
City of Auburn	128	296			2917
City of Breda	77	477			4701
City of Lanesboro	359	152			1498
City of Manson	869	1898			18705
Lake City	868		1649	2699	17020
Twin Lakes Sanitary Sewer District STP	581	898			8850
City of Jefferson	125		237	388	
City of Lake View	35		66	107	
City of Lohrville	12		22	36	
City of Lytton*	582	305			21256
City of Rinard	2		4	6	
City of Scranton	16		31	51	
Rockwell City	61		116	190	
City of Coon Rapids	232	1305			12861
City of Lidderdale	70	186			1833
DNR Springbrook State Park-Campground Area	4		8	13	
DNR Springbrook State Park-Education Center	1		2	4	
City of Bayard	14		27	45	
City of Carroll	1021		1940	3175	
City of Glidden	34		64	105	
City of Dedham	98	280			2759
City of Guthrie Center	1374	1668			16438
City of Halbur	65	213			2099
City of Redfield	742	833			8209
Diamond Head Lake	118	509			5016
City of Bagley	10		18	30	
City of Panora	122		232	379	
City of Stuart	46		88	144	
Rose Acre Farms, Inc. Guthrie Center Egg Farm	370		703	1151	
West Central Cooperative	3		6	9	
City of Callender	297	424			4179
City of Churdan	68	418			4119
City of Harcourt	9		17	29	
City of Minburn	186	391			3853
City of Paton	50	265			2612
City of Pomeroy	518	710			6997
City of Rippey	53	319			3144

	Col 1	Col 2	Col 3	Col 4	Col 5
Country View Estates	8	42			414
Ortonville Business Park	3	144			1419
City of Adel	133		252	413	
City of Desoto	27		52	85	
City of Earlham	35		67	109	
City of Farnhamville	12		22	36	
City of Gowrie	28		53	87	
City of Perry	992		1885	3085	
Tyson Fresh Meats Perry	1512		2873	4702	
Iowa Dot Rest Area #21 & #22 I80 Waukee	62	287			2828
City of Van Meter	257	866			8534
City of Waukee	138		263	430	
City of Dallas Center	43		82	134	

*Lytton load is calculated as 50 lbs/day from
Proliant and 8.2 lbs/day from domestic sources

Daily LTA Multiplier

Maximum Daily Limit (MDL)

$$MDL = LTA \cdot e^{[z\sigma - 0.5\sigma^2]}$$

where: $\sigma^2 = ln[CV^2 + 1]$

z = 1.645 for 95th percentile occurrence probability, and

z = 2.326 for 99th percentile occurrence probability

CV	LTA multipliers $e^{[z\sigma - 0.5\sigma^2]}$	
	95th percentile	99th percentile
0.1	1.17	1.25
0.2	1.36	1.55
0.3	1.55	1.90
0.4	1.75	2.27
0.5	1.95	2.68
0.6	2.13	3.11
0.7	2.31	3.56
0.8	2.48	4.01
0.9	2.64	4.46
1.0	2.78	4.90
1.1	2.91	5.34
1.2	3.03	5.76
1.3	3.13	6.17
1.4	3.23	6.56
1.5	3.31	6.93
1.6	3.38	7.29
1.7	3.45	7.63
1.8	3.51	7.95
1.9	3.56	8.26
2.0	3.60	8.55

EPA

Monthly LTA Multiplier

Average Monthly Limit (AML)

$$AML = LTA \cdot e^{[z\sigma_n - 0.5\sigma_n^2]}$$

where: $\sigma_n^2 = ln[CV^2/n + 1]$.

- z = 1.645 for 95th percentile occurrence probability, and
- z = 2.326 for 99th percentile occurrence probability
- n = number of samples/month

CV	LTA multipliers $e^{[z\sigma_n - 0.5\sigma_n^2]}$ 95th percentile					99th percentile				
	n=1	n=2	n=4	n=8	n=30	n=1	n=2	n=4	n=10	n=30
0.1	1.17	1.12	1.08	1.06	1.03	1.25	1.18	1.12	1.08	1.04
0.2	1.36	1.25	1.17	1.12	1.06	1.56	1.37	1.25	1.16	1.08
0.3	1.55	1.38	1.26	1.18	1.09	1.90	1.59	1.40	1.24	1.13
0.4	1.75	1.52	1.36	1.25	1.12	2.27	1.83	1.56	1.33	1.18
0.5	1.96	1.66	1.46	1.31	1.16	2.68	2.09	1.72	1.42	1.23
0.6	2.13	1.90	1.55	1.38	1.19	3.11	2.37	1.90	1.52	1.28
0.7	2.31	1.94	1.65	1.45	1.22	3.56	2.66	2.08	1.62	1.33
0.8	2.48	2.07	1.75	1.52	1.26	4.01	2.96	2.27	1.73	1.39
0.9	2.64	2.20	1.85	1.59	1.29	4.46	3.26	2.46	1.84	1.44
1.0	2.79	2.33	1.95	1.66	1.33	4.90	3.59	2.66	1.96	1.50
1.1	2.91	2.45	2.04	1.73	1.36	5.34	3.91	2.90	2.07	1.56
1.2	3.03	2.56	2.13	1.80	1.39	5.76	4.23	3.11	2.19	1.62
1.3	3.13	2.67	2.23	1.87	1.43	6.17	4.55	3.34	2.32	1.68
1.4	3.23	2.77	2.31	1.94	1.47	6.56	4.86	3.56	2.45	1.74
1.5	3.31	2.86	2.40	2.00	1.50	6.93	5.17	3.78	2.58	1.80
1.6	3.38	2.95	2.48	2.07	1.54	7.29	5.47	4.01	2.71	1.87
1.7	3.45	3.03	2.56	2.14	1.57	7.63	5.77	4.23	2.84	1.93
1.8	3.51	3.10	2.64	2.20	1.61	7.95	6.06	4.46	2.98	2.00
1.9	3.56	3.17	2.71	2.27	1.64	8.26	6.34	4.68	3.12	2.07
2.0	3.60	3.23	2.78	2.33	1.68	8.55	6.61	4.90	3.26	2.14

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